The relationship between serum total sialic acid levels and adenosine deaminase activity in obesity

Naciye Kurtul, PhD, Ersin Akarsu, MD, Sebnem Aktaran, MD.

Objective: To evaluate the relationship between serum adenosine deaminase (AD) activity and serum total sialic acid (TSA) levels in obese individuals.

Methods: We performed this study at the Department of Chemistry, Division Biochemistry, Kahramanmaras Sutcu Imam University Arts and Science Faculty, Turkey from 2003 to 2004. Fifty obese subjects and 25 non-obese healthy controls were included in the study. The serum AD activity and TSA concentrations were measured by spectrophotometric methods.

Results: The AD activity (p<0.01) and TSA concentrations (p<0.001) were significantly higher in the sera of obese subjects than those of non-obese control subjects. But, there was no statistically significant difference in the serum TSA levels and AD activity of the obese subjects with metabolic syndrome properties compared with those without metabolic syndrome properties. A significant correlation between the serum TSA and AD was found in the obese subjects (p<0.05, r: 0.33).

Conclusion: Our findings suggest that there may be a closer interaction between the inflammatory events and obesity. However, our observations need to be confirmed by further studies to understand more regarding the underlying mechanisms.
enzymes that specifically catalyzes the deamination of adenosine to inosine to the regulation of intracellular and extracellular concentrations of adenosine, and probably modulates energy metabolism.\textsuperscript{10-12} The physiological function of AD is crucial in regulating the steady state concentrations of adenosine in a variety of systems, especially in immunology, neurological and cardiovascular systems.\textsuperscript{12} Adenosine is an anti-inflammatory agent.\textsuperscript{13} Also, adenosine directly acts to stimulate insulin activity via several processes such as glucose transport, lipid synthesis, pyruvate dehydrogenase activity, leucine oxidation and cyclic nucleotide phosphodiesterase activity. Therefore, adenosine and AD play an important role for modulating the bioactivity of insulin.\textsuperscript{11,14,15} On the other hand, insulin resistance emerges as an important variable linking obesity to disease risks and outcomes.\textsuperscript{5} Thus, it may be useful to evaluate serum AD activity and TSA levels in obesity. The present study was undertaken to investigate the alteration of serum AD activity and also serum TSA concentrations in the obese individuals.

Methods. This study was performed at the Department of Chemistry, Division of Biochemistry, Kahramanmaras Sutcu Imam University Arts and Science Faculty, Turkey from 2003 to 2004. Obese subjects were selected from the Department of Endocrinology and Metabolism, Gaziantep University Medical Faculty. A total of 50 obese subjects (22 males and 28 females; average age: 42.2 ± 10.8 years) were included in the study. All obese and control subjects were volunteer for the study. An informed consent was obtained from all subjects and an ethical approval was also obtained. Obesity was defined using the body mass index (BMI), calculated as weight/height\textsuperscript{2} (kg/m\textsuperscript{2}). A participant who has a BMI of ≥30 kg/m\textsuperscript{2} was considered to be obese. A part of the obese subjects (n=22) who have metabolic syndrome properties including abdominal obesity (a waist circumference ≥102 cm for men and ≥88 cm for women), hypertension (≥130/≥85 mm Hg), and hypertriglyceridemia (>150 mg/dL) and lower high-density lipoprotein (HDL) (<35 mg/dL) or both.\textsuperscript{16} The control group consisted of 25 age matched, non-obese, healthy subjects (14 males and 11 females; average age: 39 ± 9.5 years). Exclusion criteria were diabetes and impaired oral glucose tolerants (checked by administrated 75 g glucose before each blood sample taken), hypertension, cancer, autoimmune disease, and coronary heart disease and the use of vitamin or mineral supplements or medications such as corticosteroids and colchicines. The systolic and diastolic blood pressure of subjects was measured by sphygmomanometer. Blood samples (5 mL) were drawn after an overnight fasting (12-14 hour) in all subjects and were stored at -40°C until assayed. Serum TSA was measured with the Denny’s colorimetric method.\textsuperscript{17} Serum AD activities were estimated spectrophotometrically by the method of Giusti,\textsuperscript{18} which is based on the direct measurements of the formation of ammonia produced when AD acts in excess of adenosine. Results were expressed as units per liter of serum (U/L). One enzyme unit was the amount of enzyme necessary to convert 1 µM of adenosine to inosine and ammonia per min at 37°C. All chemicals in this study were of analytical grade and purchased from Sigma (Stockholm) and Merck Chemicals Co. (Germany). All solutions were prepared in deionized and distilled water. In addition, total cholesterol, HDL-cholesterol and triglyceride were measured in all blood samples. Routine biochemical analyses were made by an autoanalyzer (Roche-Modular System) using commercial kits. Data were analyzed by using SPSS® for Windows computing program. For simple comparisons between 2 values, the unpaired Student’s t test was used. The p-values of <0.05 were regarded as statistically significant. Bivariate comparisons were examined using Pearson rank correlation coefficients (r). Results were expressed as means ± standard deviation (X ± SD).

Results. Results were given in Table 1. The AD activity (p<0.01) and also TSA concentrations (p<0.001) were significantly higher in the sera of obese subjects than those of nonobese control subjects. But, there was no statistically significant difference in the

| Table 1 - Serum adenosine deaminase activity (ADA) and serum total sialic acid (TSA) concentrations of subjects. |
|---|---|---|
| Group | TSA (µg/mL) | ADA (U/L) |
| **Control (n=25)** | 466.20 ± 119.65 | 14.58 ± 3.90 |
| Female (n=11) | 426.58 ± 74.22 | 13.31 ± 4.62 |
| Male (n=14) | 487.54 ± 136.03 | 15.27 ± 3.45 |
| **Obese (n=50)** | 692.25 ± 259.90*** | 19.24 ± 5.46†† |
| Female (n=28) | 706.61 ± 283.91** | 19.06 ± 5.98†† |
| Male (n=22) | 637.70 ± 131.16§ | 19.88 ± 3.15§§ |

Values represent mean ± SD, *p<0.01 versus controls, \**p<0.001 versus controls, \|p<0.05 versus control females, \***p<0.001 versus control female, \p<0.05 versus control males, \|p<0.01 versus control males
serum TSA levels and also in the serum AD activity of the obese subjects with metabolic syndrome properties compared with those without metabolic syndrome properties. When considering the gender of the obese subjects, both male and female had a higher serum TSA level and AD activity than the male and female control subjects. A significant correlation between the serum TSA and AD was found in the obese subjects ($p<0.05, r: 0.33$).

**Discussion.** This study demonstrates that obesity is associated with increased serum AD activities and increased serum TSA levels. This study is the first assessing inflammatory related parameters—serum AD and serum TSA that were investigated together in obesity. Among the individuals with obesity of unknown etiology, there is a large group of people whose obesity is connected with inflammation. Inflammation is responsible for tissue injury in pathological conditions ranging from myocardial infarction to rheumatoid arthritis. Many obese people have elevated levels of CRP which are a known sensitive marker for systemic inflammation. Adenosine has been suggested to be critical regulator of inflammation and increased adenosine release could be utilized to diminish inflammation. The AD catalyzes the deamination of adenosine to inosine contributing to the regulation of intracellular and extracellular concentrations of adenosine, and probably modulates energy metabolism. Systemic administration of an AD inhibitor produce clear anti-inflammatory effects. This action may result from the local tissue elevations of adenosine with activation of higher affinity peripheral adenosine A2a receptors on inflammatory cells. Activation of adenosine receptors (A1, A2a, A2b, A3) on a number of vascular and immune cells can modify multiple aspects of the inflammatory process. We have observed that serum AD activities were higher in obese subjects than those in the nonobese healthy subjects. The finding suggests that there may be an interaction between obesity and inflammation. In addition, increased AD activity may be related to inflammatory process in obesity. In the literature, there were limited studies encountered on serum AD activity in obesity. It has been reported that AD activity, probably through modulation of adenosine concentration, may have a significant effect on the BMI. Another inflammation marker is TSA. In addition, elevated concentrations of serum TSA were suggested as a potent cardiovascular risk factor in the general population. Moreover, raised serum TSA concentrations have been shown to predict cardiovascular and cerebrovascular mortality. Large epidemiologic studies have shown that obesity is a risk factor for cardiovascular disease (CVD). The reason for the association of TSA with CVD is unclear. But, a plausible explanation is that serum TSA has been shown to be a good marker acute phase response. Recently, there have been reports suggesting that an acute phase response mediated by cytokines may be involved in obesity, insulin resistance and metabolic syndrome X. But, we did not measure the acute phase reactants, in this study. However, elevated serum TSA levels might reflect the CVD risk in obese subjects. Furthermore, it has been shown that serum TSA is related to markers of obesity and adipose tissue metabolism which may help to explain why it is a reputed cardiovascular risk factor and also it has been shown that serum TSA is positively correlated with individual BMI.

Our study shows that serum TSA levels and serum AD activities were increased in obese individuals. In addition, there was a significant correlation between the serum TSA and AD in the obese subjects. But, there was no statistically significant difference in the serum TSA levels and also in the serum AD activity of the obese subjects with metabolic syndrome properties compared with those without metabolic syndrome properties. Therefore, the results of the present study suggest that increased serum AD activity and TSA concentration are directly related to obesity but not metabolic syndrome properties.

In conclusion, our findings suggest that there may be a closer interaction between the inflammatory events and obesity. However, our observations need to be confirmed by further studies to understand more regarding the underlying mechanisms.

**References**


